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Utilization of the Chicken Feet and Skeleton Meat for the Production of Dried Chicken Soup

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ABSTRACT

This study aimed to utilize chicken feet and skeleton meat to prepare dried chicken soup. Four formulas were prepared from dried chicken feet and Skeleton meat (50 and 50 %), (70 and 30 %),(80 and 20 %) and (100 and 0.0 %) R1, R2, R3 and R4 respectively of dried chicken soup with addition to two commercial dried soup (Maggi and Knorr) were also investigated. The chemical composition, physical and chemical quality attributes, biological evaluation and the sensory evaluation were studied. The results obtained indicated that all dried chicken soup (R1, R2, R3 and R4) samples were best in nutritional value when compared with commercial dried soup (Maggi (R6) and Knorr (R5)). Protein content of R1, R2, R3 and R4 were (44.7, 44.7, 44.9 and 44.9 %) respectively, while it was in the commercial dried soups (Maggi and Knorr) 3.8 and 3.4 %. The formulas R1, R2, R3 and R4 are significantly higher content of calcium, phosphorus, iron and boron when compared with commercial dried soup (Maggi and Knorr). Amino acids content of R1, R2, R3 and R4 was significantly higher than commercial dried soup (Maggi and Knorr). The results of biological evaluation indicated that there are no significant differences between all dried chicken soup (the same trend was noticed) for (D.T), (B.V) and (N.P.U). Also the results indicated that there are no significant differences ($P \leq 0.05$) for sensory evaluation between dried chicken soup (R1, R2, R3 and R4) samples and commercial dried soup (Maggi and Knorr) samples.

Key words: Chicken feet, skeleton meat, dried chicken soup

Introduction

The development of new food products has been studied, through the discovery of new sources of food or the reuse of by-products or wastes. For this, nutritional and sensory aspects should be taken into account, so they could supply some vitamin or minerals without rejection the product by the consumers. In this context, there are the so-called functional foods (Barcelos *et al*., 2002; Barimalaa and Okoroji, 2009 and Rodrigues *et al*., 2011). According to Laufenberg *et al*. (2003), the meat waste may contain many substances with high values. If employing an appropriate technology, this material can be converted into commercial products or raw materials to secondary processes.

In this way, several food wastes disposed previously as useless currently are transformed into by-products with wide commercial acceptance. An alternative to take advantage of the waste is the development of new products, providing a better destiny with higher commercial value to them. With the increasing world population, it is necessary to search for alternative foods to meet demand. However these alternative sources should have not only nutritive food produced at large scale with low cost, but also should present good sensory characteristics (Costa *et al*., 2008). The raw material considered as waste in some regions can be the base of traditional by-products with high added value in other regions. For instance, in some Asian countries, chicken feet are a delicacy, but in Brazil, the consumers do not have much interest in these products. The sale of a ton of chicken feet is below 1.0 R$ ton-1. These characteristics of national market are crucial to define its low sale price. Padilha *et al*. (2006) reported that by-products of the slaughtering and processing of chickens were viscera, head, feet, skin, fat, bone.

Chicken feet contain a large amount of protein 22.46%, and collagen is the major component of protein (Polian, 2012). Japanese studies have found 4 proteins in the chicken feet that contained collagen with actions similar to the blood pressure medication when tested in rats. Chicken leg and feet contain collagen more than chicken breast meat. Chicken collagen hydrolysate was prepared in the study and fed to rats and the effects on blood pressure were examined. The rats showed a drop-in blood pressure after 4 hours of receiving the mixture orally, with the lowest blood pressure reading after 8 hours. The study showed improved blood pressure after 2 weeks (Ai *et al*., 2008). Food and pharmaceutical industries throughout the world are observing a growing

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demand for collagen and gelatin. The collagen protein substance is naturally occurring in the human body, but the problem occurs with age progress, the body's ability to produce less collagen, which leads to changes in flexibility and increase in the inflammatory pain and arthritis so it is recommended to take collagen from another source. The most popular and used is the gelatin of mammals (pigs and cattle) that are subjected to greater restrictions and skepticism among consumers, by socio-cultural and health concerns (Karim and Bhat, 2009). This demand for new gelling agents to replace the gelatin of mammals has guided several studies on different raw materials. Collagen is formed mainly from connective tissue of animals. It has a specific secondary structure known as triple helix ,which confers strength to the connective tissue matrix. This includes all the myofibril cells allowing coordinated action of movement (Hernandez-Briones *et al*., 2009). Value addition and effective utility of this products can be enhanced by processing the chicken feet into ready-to-use convenient products such as chicken soup mixes. These types of products are becoming more popular in the consumer market. Globalization of industry has further opened global markets for the chicken-based products. Hence, there is a growing demand for products like chicken all over the soup mix (dehydrated) world. Further, soup would stimulate the appetite and flow of digestive juices in stomach and normally they are consumed before meal.

This study aims to take advantage of the nutritional value and the benefits of the healthy ingredients of chicken feet and skeletons meat in the production of desirable food product (dried chicken soup) with economic price and to study the chemical composition , the physical and chemical quality attributes and the sensory evaluation of chicken feet and skeletons meat soup product.

Materials and Methods

Raw materials.

Chicken feet and chicken skeleton were obtained from the local market at Giza, Egypt. Immediately after slaughtering, the samples were transported using an ice box to the laboratory of Meat and Fish Technology, Food Technology Research Institute. Other ingredients such cardamom - white pepper - ginger - sugar - salt - starch – mastica gum (mestica) - dried garlic - dried onions - ascorbic acid were purchased from the local market at Giza.

Two kinds of commercial dried soups (Maggi and Knorr) were obtained from a local super market.

Preparation of ready to use dried chicken soup mix (made from chicken feet and Skeleton meat) the process comprising the following steps.

A- The dried meat of chicken feet

1- The chicken feet were cleaned, washed thoroughly and soaked in boiling water for 3 minutes and the surface yellow membranes on the feet was peeled
2 –The chicken feet were cooked under pressure for 45 minutes (1 kg feet in 1 litter water).
3 –Cooked chicken feet were separated and the remained liquid was concentrated
4 –The bones were removed from cooked mass to obtain the deboned feet meat
5 –The deboned meat of chicken feet was minced and added to the concentrated liquid with 10% by weight starch. The mixture was blended to obtain slurry.
6 – The ground slurry was dried at 50 ^{0}C for 24 hour
7– The dried meat of chicken feet was grinded

B- The dried meat of chicken skeleton

The same producer was carried out for dried meat chicken skeleton as in the preparation of dried meat chicken feet**.**

C- Preparation of ready to use dried chicken soup mix (made from chicken feet and skeleton meat)

The ingredients were mixed in the proportions shown in Table (1) for the formation of R1, R2, R3 and R4

D-The ingredients of the commercial samples

The ingredients of the commercial samples Maggi (R6) and Knorr (R5) were as follows (according to their labels

Knorr ingredients (sample R5)

Salt, corn starch, sugar, mono sodium glutamate, chicken flavor (contains egg and milk products), carrot, concentrate, dried parsley, onion flavor (contains: soy), disodium glutamate, disodium inosinate, dried spices (cumin and curcuma) coriander oil, dried chicken meat and garlic oil.

Maggi ingredients (sample R6)

Salt, vegetable fat, sugar, wheat flour (gluten), flavor enhancer (mono sodium glutamate, disodium inosinate and disodium guanylate), onion, yeast extract, spices, flavors, caramel color, citric acid and dehydrated chicken meat. May contain traces of milk protein. Where, R1, R2, R3 and R4compared with R5 and R6

Chemical analysis.

Proximate analysis including moisture, total protein, fat, ash and fiber were carried out according to the methods of (AOAC, 2005). Carbohydrates content was calculated by difference. Iron, calcium and boron were determined according to (AOAC, 2005). Perkin Elmer (Model 3300, USA) Atomic Absorption Spectrophotometer was used to determine these minerals. Total phosphorous was determined using common colorimetric method described by (AOAC, 1995). Amino acids were determined according to Milliporo Co-operative (1987). Mono Sodium Glutamate content was determined for Maggi (R6) and Knorr (R5) only was according to Rodriguez *et al*. (2003)

Table 1: Ingredients (%) used in the preparation of different dried chicken soup

Ingredients \ Formula No	R1	R2	R3	R4
The dried meat of chicken feet	37.15	52.01	59.44	74.3
The dried meat of chicken skeleton	37.15	22.29	14.86	-
Dried Knorr soup (R5)	-	-	-	-
Dried Maggi soup (R6)	-	-	-	-
White paper	1.3	1.3	1.3	1.3
Sugar	0.2	0.2	0.2	0.2
Salt	15	15	15	15
Ginger	0.5	0.5	0.5	0.5
Dried garlic	0.4	0.4	0.4	0.4
Dried onions	2.5	2.5	2.5	2.5
Skim milk	5	5	5	5
Mastica gum(mestica)	0.1	0.1	0.1	0.1
Cardamom	0.5	0.5	0.5	0.5
ascorbic acid	0.2	0.2	0.2	0.2

R1= (50% The dried meat of chicken feet + 50% The dried meat of chicken skeleton meat) of dried meat additive.
R2= (70% The dried meat of chicken feet + 30% The dried meat of chicken skeleton meat) of dried meat additive.
R3= (80% The dried meat of chicken feet + 20% The dried meat of chicken skeleton meat) of dried meat additive.
R4= (100% The dried meat of chicken feet) of dried meat additive.
R5 = Dried Knorr soup.
R6 = Dried Maggi soup.

Chemical quality attributes.

Total volatile nitrogen (T.V.N) was determined according to (Winton and Winton, 1958), thiobarbituric acid (T.B.A) value was determined according to (Pearson, 1970) and pH value was determined according to (Aitken, *et al*. 1962).

Physical quality attributes

Viscosity of the Resultant Soup Samples

Viscosity of dried chicken soup samples were measured according to Brookfield Manual (1998) by using Brookfield Engineering labs DV-III Ultra Rheometer. The sample was placed in a small sample adapter and a constant temperature water bath was used to maintain the desired temperature. The viscometer was operated between 10 and 60 rpm. Viscosity data were obtained directly from the instrument, the SC4-21 spindle was selected for the measurement. Viscosity measurements were made on the resultant soup samples at room temperature (25˚C ± 1˚C).

Rehydration Ratio (RR)

Rehydration ratio was performed according to Krokida and Marinos-Kouris (2003). A given weight (2 g) of the dried chicken soup mixtures were rehydrated in 20 ml distilled water in a water bath at room temperature, that was agitated at constant speed (100 rpm). The samples were taken from the bath after 10 minutes and were weighted after being blotted with tissue paper in order to remove the excess solution. Rehydration ratio was defined as the ratio of weight of rehydrated samples to the dry weight of the sample.

Turbidity

The turbidity of the liquid was determined by measuring the absorbance (A) at 900 nm in 1 cm cuvette cells against Milli-Q water (Bses, 2001a). The absorbance was obtained using a Cintra 40 double-beam UV-visible spectrophotometer (GBC Scientific Equipment Pty. Ltd., Braeside, VIC, Australia) and the turbidity was calculated as 100×A. The error for turbidity determination was ± 0.5%.

Biological evaluation

Animal feeding trials for biological evaluation:

Experiments were carried out according to the procedure of Eggum, (1973) using adult male allrion rats. The animals are weighted at the beginning of the experiment as well as at the changing from pre- period to experimental period and again at the end of the experiment. Urine is collected in 50 ml 5 % H_2SO_4, while the faeces in 100 ml H_2SO_4 . At the end of the experiment the rats were weighted and sacrified with di-ethyl ether. An eventual feed is weighted.

Nitrogen of urine and faeces was determined according to the microkeljhal method described by AOAC (2005). True digestibility (T.D), biological value (B.V) and net protein utilization (N.P.U) were calculated according to the following equations:

$$\mathrm{T.D} = \frac{\text{N intake} - (\text{ faecal N} - \text{metabolic N} \quad \text{x } 100}{\text{N intake}}$$

$$\mathrm{B.V} = \frac{\text{N intake} - (\text{ faecal N} - \text{metabolic N}) - (\text{urinary N} - \text{endogenous}) \quad \text{x } 100}{\text{N intake} - (\text{ faecal N} - \text{metabolic N})}$$

$$\mathrm{N.P.U} = \frac{\mathrm{T.D} \quad \text{x } \mathrm{B.V}}{100}$$

Where : N = nitrogen

Sensory evaluation and its Statistical analysis

Sensory evaluation of the dried chicken soups was carried out. Twenty panel tester were employed to evaluate the color, odor, taste and overall acceptability. Ranking method was used to find out the best product which had the lowest sum of ranks, according to international standards, Iso 8587 (1980) and Basker, (1988). The critical values of differences among the sum of ranks were used for testing the significant differences between the products, where, the significance is attained when the rank sum difference are greater than or equal to the critical differences (sorted from the table of critical values of differences between rank sums).

Statistical analysis.

The obtained data were exposed to analysis of variance followed by multiple comparisons between means ($P \leq 0.05$) applying LSD. The analysis was carried out using the PRO ANOVA procedure of Statistical Analysis System **(SAS, 1996).**

Results and Discussion

Chemical composition of different formulas of chicken soup powder (made from chicken feet and Skeleton meat) and commercial soups (Maggi and Knorr)

From data presented in table (2), it could be noticed that there were significant differences ($p \leq 0.05$) in moisture content between all kinds of dried chicken soups. The moisture content of different type of chicken soup made from chicken feet and skelton (R1,R2,R3 and R4) were higher than commercial samples (magi and konrr). Also it could be observed that the moisture content of R4 (100% dried meat of chicken feet) was significantly the highest (6.20%) followed by R3 (80 % dried meat of chicken feet and 20 % dried meat of chicken skeleton) and R2 (70 % dried meat of chicken feet and 30% dried meat of chicken skeleton) , where R1 (50% dried meat of chicken feet and 50 %dried meat of chicken skeleton) had significantly the lowest moisture content (4.3 %) .

From the same table it could be noticed that there were significant differences ($p \leq 0.05$) in protein content of dried chicken soup made from chicken feet and skeleton (R1,R2,R3 and R4) and the protein content of commercial samples (Maggi and konrr). Protein content of dried chicken soups made from chicken feet and skeleton(R4,R3,R2 and R1) was significantly higher than commercial samples (Maggi and konrr), where R4,R3,R2 and R1 recorded 44.9,44.9,44.7 and 44.7 % protein, while commercial samples (Maggi and konrr), recorded 3.8 and 3.4 %, respectively. This indicated that the chicken soup made from chicken feet and skeleton meat are rich in protein, Fatima, (2013) studied the protein content of magge cube (vegetable, chicken and beef) and mushroom broth cube, she found that the protein content of the chicken cube was the highest protein content (8.6%) followed by mushroom broth cube(7.9 %) and beef cube was (6.9%) while the vegetable cube had the lowest protein content (4.8%) on dry weight basis.

Results in table (2) indicated that there were significant differences (p≤0.05) in fat content of different kinds of chicken soup (made from chicken feet and skeleton meat) and commercial Maggi and Knorr, where chicken soup (made from chicken feet and skeleton meat) ranged between 22.03 to 25.73 % while commercial Maggi and Knorr were 23.69 and 0.28%, respectively, the lowest fat content in the Knorr samples (R5) may be due to the decrease of fat sources in this samples. On the other hand it could be noticed that R4 had the highest fat content followed by R3, R2 and R1, this may be attributed to increasing the percentage of dried meat of chicken feet in R4 followed by R3, R2 and R1 . Fatima, (2013) found that fat content (on dry weight basis) of mushroom cubes and traditional Maggi cubes (vegetable, chicken and beef) was 3.8, 2.9, 4.7 and 3.5 %, respectively.

From the obtained results in table (2), it could be found that there were significant differences (p≤0.05) in ash and crude fiber content of different kinds of chicken soup (made from chicken feet and skeleton meat) and commercial Maggi and Knorr, where ash and crude fiber content of different formulas of chicken soup (made from chicken feet and skeleton meat) were fairly significantly lower than the commercial Maggi and Knorr. They ranged from 2.29 to 4.2 % and 0.87 to 1.25% in dried chicken soup (made from chicken feet and Skeleton meat), respectively. While ash and crude fiber were 5.36 and 7.96 % and 0.95 and 1.69% in commercial Maggi and Knorr, respectively. Fatima (2013), found that total fiber of mushroom cubs, vegetable cubes, chicken cubes and beef cubes were3.7, 38.1, 25.9 and 27.5 %, respectively.

Carbohydrates content of R1, R2, R3 and R4 were significantly lower than commercial Maggi and Knorr, where R1, R2, R3 and R4 recorded 24.00, 22.19, 20.43 and 19.74 %, while commercial Maggi and Knorr recorded 63.05 and 86.47 %, respectively. The results obtained were not in accordance with obtained results by Fatima (2013), who found that carbohydrates content (on dry weight basis) of mushroom cubes, vegetable cubes , chicken cubes and beef cubes were 35.1, 23.4, 41.2 and 4.2 %, respectively.

Table 2: Chemical composition of different kinds of chicken soup (made from chicken feet and Skelton) and traditional Maggi and Knorr

Contents % (on dry weight basis)	Dried chicken soup						
	R1	R2	R3	R4	R5	R6	LSD
Moisture	4.3c±0.2	5.1b±0.3	5.4b±0.5	6.20a±0.4	1.30e±0.2	3.30d±0.3	0.608
Protein	44.7a±0.6	44.70a±0.5	44.90a±0.8	44.90a±0.2	3.40b±0.4	3.80b±0.6	0.977
Fat	22.03d±0.3	22.98c±0.4	23.82b±0.2	25.73a±0.2	0.28e±0.1	23.69b±0.4	0.520
Ash	4.1c±0.3	4.10c±0.3	4.20c±0.2	2.29d±0.2	7.960a±0.4	5.360b±4.4	0.553
Carbohydrates	24.0c±0.3	22.19±0.3	20.43e±0.2	19.74f±0.2	86.47a±0.3	63.05b±0.3	0.479
Crude fiber	0.87c±0.2	0.93c±0.2	1.25b±0.2	1.14bc±0.2	1.69a±0.3	0.90c±0.3	0.409

The letter a, b, c, d, e and f means with in a raw followed by the same letter are non – significantly different (P≤ 0.05).

Minerals content

Results in table (3) indicated that there were significant differences (P≤ 0.05) in calcium, phosphorus, iron and boron contents in different kinds of chicken soup (made from chicken feet and skeleton meat) and commercial Maggi and Knorr. Whereas, R2 had the highest level of calcium (5.3 mg/ kg) followed by R1, R3, R4, R6 and R5 that recorded 4.8, 4.2, 3.9, 0.97 and 0.90 mg /kg, respectively. While R1 recorded the highest level of phosphorus (4.0mg/kg) when compared with R2, R3, R4, R6 and R5 recording 3.6, 3.4, 3.0, 0.6 and 0.1 mg/ kg, respectively. Iron content ranged from 19.45 to 175.3 mg/ kg there were significant differences (P≤ 0.05) in iron content of different samples of chicken soups. The iron content of R3 is significantly higher than the other soups while that of R 5 is significantly lower than the other soups. On the other hand,with boron content there is significant differences(P≤ 0.05) in different samples of chicken soup (made from chicken feet and skeleton meat) and commercial Maggi and Knorr where boron content of R1(7.6 mg/kg) is significantly higher than the other samples of chicken soups. On the other hand, R6 (1.69 mg/kg) is significantly lower than the other soups while there is no significant differences (P≤ 0.05) between R5 and R6 (1.99 and1.69 mg/kg, respectively).This is relatively similar to results obtained by (Obiakor- Okeke *et al*., 2014), who found that mineral content (Calcium , Phosphorus, Iron) of four traditional soup consumed in Igebere community, Abia state ranged between 41.4 to 74.8 , 19.9 to 55.3 and 0.23 to 0.39 mg /100gm, respectively.

Generally, it could be noticed that all minerals contents were significantly higher in the chicken soups (made from chicken feet and skeleton meat) compared with the other commercial Maggi and Knorr soups. This may be due to the higher content of chicken meat in the samples made from chicken feet and Skeleton meat

Table 3: Minerals content of different kinds of chicken soup (made from chicken feet and Skeleton meat) and commercial Maggi and Knorr

Minerals	Dried chicken soup						
Mg/kg	R1	R2	R3	R4	R5	R6	LSD
Calcium	4.8b±0.15	5.3a±0.15	4.2c±0.1	3.9d±.05	0.9e±.05	0.97e±.05	0.181
Phosphorus	4.0a±0.05	3.6b±0.05	3.4c±0.05	3.0d±0.01	0.1f±0.01	0.6e±0.01	0.064
Iron	119.9d±0.4	120.9c±0.4	175.3a±0.5	150.8b±0.5	19.45f±0.05	29.19e±0.1	0.662
Boron	7.6a±0.4	5.5b±0.4	4.4c±0.2	3.4d±0.1	1.99e±.04	1.69e±.04	0.444

The letter a, b, c, d, e and f means with in a raw followed by the same letter are non – significantly different (P≤ 0.05).

Amino acids of different kinds of chicken soup

Table (4) showed the amino acids content of different types of chicken soup, from this table, it could be noticed that there were significant differences (P≤ 0.05) in amino acids levels between different kinds of chicken soup, R1 had significantly the highest content of some amino acids (aspartic, therionine, serine, glutamic, isoleucine, tyrosine, phenylalanine, lysine and methionine), while R3 had significantly the highest content of alanine and R4 had significantly the highest content of glycine, histidine, arginine and proline. These results are similar to the amounts in defatted freeze- dried chicken soups (Jayasena *et al*., 2015). Amino acids are necessary for vital functions for building tissues in the human body and for flavor development and therefore enhancing edible value of meat (Toldra, 1998; Lim *et al*., 2013) . For instance, amino acids such as glycine, alanine, lysine and serine have been shown to be closely associated with a sweet flavor whereas glutamic acid and aspartic contributed to the pleasantly fresh or umami taste of meat. On the other hand , valine, isoleucine, leucine, phenylalanine, methionine, arginine and histadine are assocatiated with a bitter taste (Zhu and Hu, 1993; Lim *et al*., 2013)

From this data, it could be noticed that, the amino acid content in the commercial samples (Maggi and Knorr soups) were very low compared with the other samples, this may be due to the decrease of protein content in these two samples (3.8 and 3.4 %). On the contrary it could be noticed that, glutamic contents in two samples (Maggi and Knorr soups) were very high compared with the other amino acids ,this may be due to the sodium mono glutamate added to the commercial samples (Maggi and Knorr soups) as in tables(5)

Table 4: Amino acids of different kinds of chicken soup (made from chicken feet and skeleton meat)

Amino acids % Mg/100mg sample	Dried chicken soup						
	R1	R2	R3	R4	R5 Knorr soup	R6 Maggi soup	LSD
Aspartic	3.43a±0.21	3.03b±0.03	3.01b±0.01	3.21b±0.02	0.01c±0.001	0.05c±0.01	0.166
Therionine	1.56a±0.03	1.21b±0.02	1.12c±0.02	1.23b±0.03	0.04d±0.02	0.02d±0.01	0.040
Serine	1.50a±0.05	1.34b±0.04	1.11c±0.01	1.48a±0.06	0.01e±.005	0.08±.01	0.0647
Glutamic	6.36a±0.02	5.75c±0.04	5.68c±0.04	5.83b±0.04	2.24 e ±.02	2. 27e±.02	0.0438
Glycine	4.16d±0.02	6.16c±0.03	6.26b±0.01	6.39a±0.04	0.01 f ±.005	0.07e±.01	0.0406
Alanine	3.04b±0.04	3.42a±0.02	3.44a±0.04	2.22c±0.02	0.01d±.005	0.12d±.02	0.0461
Valine	1.78a±0.04	1.48c±0.03	1.44c±0.02	1.62b±0.04	0.02e±.01	0.07d±.01	0.0498
Isoleucine	1.43a±0.03	1.23b±0.03	1.21b±0.01	1.08c±0.02	.009f±.001	0.04e±.01	0.0373
Leucine	2.60a±0.03	2.27b±0.04	2.27b±0.04	2.17c±0.02	0.01e±.005	0.10d±.005	0.0608
Tyrosine	1.48a±0.05	1.25b±0.02	1.19c±0.03	1.15c±0.01	0.02e±.01	0.20d±.05	0.0586
Phenyl alanine	1.86a±0.02	1.83a±0.03	1.74b±0.04	1.57c±0.04	0.03e±.01	0.17d±.01	0.0498
Histidine	0.91b±0.01	0.59c±0.02	0.56c±0.01	1.03a±0.03	0.008f±.001	0.04e±.01	0.291
Lysine	2.83a±0.03	2.17b±0.07	1.12c±0.02	2.07d±0.07	0.06e±.01	0.05e±.01	0.0772
Arginine	3.09c±0.05	3.24b±0.04	3.27b±0.07	4.15a±0.05	0.05e±.01	0.49d±.03	0.0790
Proline	3.10c±0.05	4.06b±0.06	4.07b±0.07	4.41a±0.07	0.01d±.01	0.06d±.01	0.0919
Cyctine	0.52c±0.02	0.60b±0.03	0.82a±0.05	0.43d±0.03	0.01f±.005	0.07e±.01	0.0504
Methionine	1.05a±0.03	0.76b±0.02	0.76b±0.02	0.55c±0.03	0.0e±	0.007d±.001	0.0370

The letter a, b, c, d, e and f means with in a raw followed by the same letter are non – significantly different (P≤ 0.05).

Mono sodium glutamate contents was determined in the commercial samples (Maggi and Knorr soups). The results shown in table (5) indicated that mono sodium glutamate contents 2.57 and 2.61 mg/ 100mg sample Maggi and Knorr soups respectively, determined as a glutamic acid, although, the protein content in these two samples was (3.4 and 3.8 mg/ 100mg samples Maggi and Knorr soups, respectively). This may be due to the addition of the mono sodium glutamate salt to the ingredients of these the commercial samples (according to their labels).

Table 5: Sodium mono glutamate content.

Samples	Sodium mono glutamate content (Mg/100mg sample)
R5	2.57
R6	2.61

R5 = Knorr soup R6 = Maggi soup

Chemical quality attributes

Statistical analysis of data in table (6) indicated that there were high significant differences (P≤ 0.05) in T.V.N contents between different kinds of dried chicken soup made from chicken feet and Skeleton meat (R1, R2, R3 and R4) and commercial Maggi and Knorr. All dried chicken soup made from chicken feet and skeleton meat (R1, R2, R3 and R4) were significantly higher than commercial Maggi and Knorr, this may be due to higher protein content in all dried chicken soup made from chicken feet and skeleton meat (R1, R2, R3 and R4) than as indicated in table (2), because there are direct relationship between protein content and T.V.N. On the other hand, it could be noticed that R4 recorded significantly the highest content of T. V. N (4.9 mg/100mg) followed by R3,R2,R1,R6 and R5 that, recorded 4.2, 3.5, 2.8, 0.7 and 0.14 mg/100mg, respectively. This may be due to that R4 had significantly the highest protein content when compared with other dried chicken soup samples.

At the same table (6), the data showed that R4 recorded significantly the highest value of pH(6.71) followed by R3,R2,R1,R6 and R5 that gave 6.67, 6.54, 6.45, 6.2 and 5.9, respectively. This is confirmed by the higher T.V.N content of R4 than formulas R3,R2,R1,R6 and R5 as there is direct relationship between T.V.N content and pH value (Sanchez- Alouso *et al*., 2007).

From data presented in table (6), it could be noticed that there were significant differences (P≤ 0.05) in T.B.A value between different type of dried chicken soup made from chicken feet and skeleton meat (R1, R2, R3 and R4) and commercial Maggi and Knorr. On the other hand, T.B.A values of R4 and R3 were significantly higher than those of the other formulas.

According to E.O.S.Q.C. (2005). T.B.A level in chicken soup should not exceed be more than 0.9 mg malonaldehyde /kg (w.w.). Generally, TBA levels in all samples were significantly lower than the allowable limit.

Table 6: T.V.N, T.B.A and PH of different kinds of chicken soup (made from chicken feet and Skeleton meat) and commercial Maggi and Knorr.

Tests	Dried chicken soup						
	R1	R2	R3	R4	R5 Knorr soup	R6 Maggi soup	LSD
T.V.N	2.80c±.13	3.5d±.32	4.20e±.26	4.90f±.20	0.14a±.04	0.7b±.31	0.417
T.B.A	0.198b±.01	0.249b±.04	0.297c±.04	0.301c±.05	0.044a±.03	0.055a±.02	0.064
PH	6.45a±.01	6.54ab±.03	6.67b±.04	6.71b±.04	5.90a±.4	6.20a±.1	0.482

The letter a, b, c, d, e and f means with in a raw followed by the same letter are non – significantly different (P≤ 0.05).
T.V.N. : Total volatile nitrogen (mg/100mg)
T.B.A. : Thiobarbituric acid (mg malonaldehyde/kg)

Physical quality attributes.

Results in table (7) showed the Physical quality attributes of different kinds of chicken soup (made from chicken feet and Skeleton) and commercial Maggi and Knorr.

The rehydration properties, rehydration rate, and rehydration capacity are important characteristics of many products, related to their later preparation for consumption (Jokić *et al*., 2009). The rehydration capacity was used as a quality characteristic of the dried product expresses in the rehydration rate (Lewicki, 1998 and Velić *et al*., 2004). When the dried foods are reconstituted, it must show acceptable textural, visual, and sensory characteristics, while the rehydration time is minimized (Sanjuan *et al*., 1999 and García-Pascual *et al*., 2006). From the results in table (7), it could be noticed that there are significant differences (P≤ 0.05) in rehydration ratio between different kinds of dried chicken soup made from chicken feet and Skeleton meat (R1, R2, R3 and R4) and commercial Maggi and Knorr. All samples of dried chicken soup made from chicken feet and Skeleton meat (R1, R2, R3 and R4) were significantly higher in rehydration ratio than the samples of commercial Maggi and Knorr. This may be due to the higher protein content in R1, R2, R3 and R4 than in samples of commercial Maggi and Knorr as shown in table (2). Protein is the most important factor that help to link water in food products and there is direct relationship between protein content and rehydration ratio. On the other hand, it could be found that R1 gave the highest rehydration ratio when compared with R2, R3 and R4. This may be due to the quality of protein, more connective tissues (more collagen) are found in R4 than in R3 and R2, respectively. While R1 contain muscle tissues (myosin) higher then R2, R3 and R4, respectively. This may be due to the presence more connective tissues that characterized the chicken feet and lower binding ability compared muscle tissues as in the skeleton meat (more myosin) Mahmoud, (2003).

Data in table (7) showed that Viscosity in all samples of dried chicken soup made from chicken feet and Skeleton meat (R1, R2, R3 and R4) was significantly higher than samples of commercial Maggi and Knorr. Where R4, R3, R2 and R1 recorded 120, 110, 90 and 60 (centipois). While commercial Maggi and Knorr recorded 40 and 20 (cantipois), respectively. This may be due to that R4, R3, R2 and R1 are rich in collagen (Polian, 2012) and collagen with heated water (when preparing the soup) converts to gel and so increase the liquid viscosity. From the same table (7), it could noticed that R4 showed the significantly highest of viscosity when compare R3, R2 and R1, respectively. This may be due to R4 had higher dried meat of chicken feet content (rich in collagen) when compared to R3, R2 and R1, respectively. Knowledge of the Viscosity behavior in foods during processing led to control in processing steps and quality control . Viscosity is an important characteristic of liquid foods in many areas of food processing (Ibanoglu and Ibanoglu, 1998 and Antonio *et al*., 2009). In soup making, viscosity is an index of thickness (Ikegwu *et al*., 2009). the dried meat of chicken feet (rich in collagen) was used as thickening agents to provide the desirable texture and viscosity to the soup mix(Abeysinghe and Illepruma, 2006).The functional properties of proteins play an important role in food formulation and processing and have been exploited in the preparation and development of soups (Boye *et al*., 2010).

Table 7: Physical quality attributes of different kinds of chicken soup (made from chicken feet and Skeleton meat) and commercial Maggi and Knorr.

Tests	dried chicken soup						
	R1	R2	R3	R4	R5	R6	LSD
Rehydration ratio	4.4a±0.2	3.81b±0.1	3.45c±0.2	3.2cd±0.18	2.3d±0.2	2.9e±0.2	0.332
Viscosity cp (centipoise)	60d±1	90c±2	110b±2	120a±2	20f±2	40±e2	3.328
Turbidity NTU	112d±2	127c±3	134.7b±4	148.2a±3	62.6f±±4	85.5e±4	6.576

The letter a, b, c, d, e and f means with in a raw followed by the same letter are non – significantly different (P≤ 0.05).
NTU= nephelomteric turbidity unit.

Turbidity is an optical characteristic or property of liquid, which in general term describes the clearness or haziness of the liquid. Turbidity has always been based on human observation and while this phenomenon is uantifiable by many different means, much discussion still exists around the various techniques used to measure turbidity of fluids.

Turbidity is not color related, but relates rather to the loss of transparency due to the effect of suspended particulate, colloidal material, or both, and it is considered very important advantages for these liquids.

From the results in table (7), it could be indicated that turbidity of all samples of dried chicken soup made from chicken feet and skeleton meat (R1, R2, R3 and R4) was significantly higher than commercial Maggi and Knorr samples. Where R1, R2, R3 and R4 recorded 112, 127, 134.7 and 148.2% distilled water. While commercial Maggi and Knorr recorded 62.6 and 85.4% distillated water, respectively. This may be due to that protein content of R4, R3, R2 and R1 were significantly higher than commercial Maggi and Knorr samples as mentioned table (2), it is known that there is positive relationship between suspended particulate , colloidal material (such as proteins) and turbidity of liquids. Also it could be indicated that R4 had significantly the highest turbidity when compared to R3, R2 and R1, (table 7). This may be due to that R4 had higher content of dried meat of chicken feet (rich in collagen) when compared to R3, R2 and R1, respectively. Collagen with heated water (when preparing the soup) converts to gel and so increase the liquid viscosity this leads to reducing the pass of the light through the liquid and increasing the turbidity.

Biological evaluation of different defatted dried chicken soup.

Growing albino rats were fed on different chicken soups, in addition to casein for composition at 10% protein level for 9 days to evaluation the nutritional quality of chicken soups. Protein was evaluated by the following biological parameters: true digestibility (T.D), biological value (B.V) and net protein utilization (N.P.U) . The obtained results are shown in (table 8). These results indicated that there are no significant differences between all kinds of soup for (T.D), (B.V) and (N.P.U) that arranged between (93.14 – 96.79), (78.60-88.61) and (74.56 – 85.54) respectively. Moreover, the same results indicated that there are no significant difference between all types of soups and the control samples (casein diet) for (T.D), (B.V) and (N.P.U)

Table 8: Biological evaluation of different defatted dried chicken soup

Parameters	Dried chicken soup					
	Control	R1	R2	R3	R4	LSD
T.D	95.46a ±4.89	95.63a±3.69	94.81a ±2.91	93.14a ±6.89	96.79a ±6.33	6.818
B.V	90.90 a ±6.20	86.88 a±12.98	78.60 a±16.50	86.27 a ±9.91	88.61 a ±6.37	14.66
N..PU	86.89a ±8.99	82.84a ±10.85	74.56a ±16.4	79.92a ±5.82	85.54a ±4.91	13.38

The letter a, b, c, d, e and f means with in a raw followed by the same letter are non – significantly different (P≤ 0.05).

Sensory evaluation of different formulas of chicken soup (made from chicken feet and Skeleton meat) and commercial Maggi and Knorr.

The results of rank method for the sensory evaluation of chicken soup (made from chicken feet and Skeleton meat) and commercial Maggi and Knorr for color, taste, odor and overall acceptability are shown in table (9). From these data, it could be noticed that, the best color was that of R6 samples followed by R4,R3 and R2, but the difference between these samples were non- significant (P≤ 0.05 or 0.01), while the R1 and R5 were significantly different than the above- mentioned samples (P≤ 0.05), but difference was found between

R2 and R1 at significant level of ($P \leq 0.01$). The best order of color was for the R6 sample (Maggi soup) this may be due to the added caramel color as mentioned on the its label. In the same table, it could be noticed that, R1, R2 and R3 samples had the best taste without significant differences, followed by R6,R4 and R5 samples with significant differences ($P \leq 0.05$). On the other hand, the odor evaluation, in the same table showed that the best odor was for R1 sample with significant differences, followed by the other samples ($P \leq 0.05$) with no significant differences between them.

Finally, the results of overall acceptability presented in table (9 and 10) , showed that , the first order was for R6 followed by R1,R2 and R3 samples but the differences between the samples were non- significant ($P \leq 0.05$). On the other hand, the worst order was R5 samples, but without significant differences with R1 samples.

Table 9: Rank method for sensory evaluation.

Samples	Rank of samples as advantage**					
	R1	R2	R3	R4	R5 Knorr soup	R6 Maggi soup
Color	5b	4a	3a	2a	6b	1a
Taste	1a	2a	3ab	5bc	6c	4b
Odor	1a	4b	5b	6b	3b	2b
Overall acceptability	2ab	3ab	4ab	5b	6b	1a

*** the number means rank, i. e., 1= best and 6 seamy the letters a, b, c, d, e and f means within a raw followed by the same letter are non – significantly different (P≤ 0.05).*

Table 10: Rank methods for overall acceptability

Significance	P = 0.05	P = 0.01
Critical difference	33.7	39.8
R6 (Maggi soup)	A	A
R1	A	A
R2	ab	Ab
R3	b	Ab
R4	bc	Bc
R5 (Knorr soup)	bc	C

Conclusion

It could be concluded that the results of this investigation pointed out the usefulness of utilizing chicken feet and skeleton meat (Four formulas R1, R2, R3 and R4) to prepare dried chicken soup as food addition of natural sources to enhance nutritional characteristics and technological quality of the dried chicken soup , as, dried chicken soups prepared from chicken feet and skeleton meat are considered good natural cheap source of animal protein, amino acids, calcium, iron. Phosphorus and boron and are free from mono-sodium glutamate harmful to human health. The results of biological evaluation indicated that no significant differences were found between all dried chicken soup. (R1, R2, R3 and R4) samples and the control samples (casein diet) for (D.T), (B.V) and (N.P.U). Also the results indicated that no significant differences ($P \leq 0.05$) for sensory evaluation were noticed between dried chicken soup. (R1, R2, R3 and R4) samples and commercial dried soup (Maggi and Knorr) samples.

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